PREPRODUCTION INITIATIVE-NELP
HYDRAULIC PURIFIER
TEST PLAN

SITE: NAS NORTH ISLAND AND NS MAYPORT

1.0 OBJECTIVE

This test plan describes the data collection procedures for acquiring performance data on two hydraulic purifier models located at the Aircraft Intermediate Maintenance Department (AIMD) activity at NS Mayport, Florida and NAS North Island, California. These data will be used to determine the efficiency, effectiveness, and overall success of the purifiers regarding their ability to recondition contaminated hydraulic fluid to levels considered acceptable for use in support equipment and aircraft hydraulic systems.

2.0 DESCRIPTION

Aircraft hydraulic fluids contaminated beyond the acceptable limits defined by Navy Standard Class 5 are currently disposed of as hazardous waste. The amount of hydraulic fluid that is considered hazardous waste can be significantly reduced if particle contamination levels are lowered to at least the levels of Navy Standard Class 3 and other contaminants are removed or significantly reduced.

Contaminated synthetic aircraft hydraulic fluids MIL-H-46170 (Hydraulic Fluid, Rust-Inhibited, Fire-Resistant) and MIL-H-83282 (Hydraulic Fluid, Fire-Resistant), when reconditioned, shall meet or exceed the following contamination levels to be acceptable for reuse:

- Reduction of particulate concentrations to at least Navy Standard Class 3
- Removal of 100% of free/entrained water
- Reduction of dissolved water concentration to at least 250 parts per million (ppm)
- Reduction of chlorinated solvent concentration to at least 100 ppm

3.0 TEST PLAN

This test plan will be used to evaluate the effectiveness of two hydraulic purifier systems—HPU-1-5, which is manufactured by Hydraulic International, Inc., and PE-00440-1H, which is manufactured by PALL Land and Marine Corporation. These systems are being evaluated for their ability to recondition aircraft hydraulic fluid to meet the parameters listed in Section 2.0.

3.1 Approach

The HPU-1-5 hydraulic purifier will be used in conjunction with the A/M27T-5 hydraulic power supply to recondition (*i.e.,* purify) aircraft hydraulic fluid, MIL-H-83282, within the T-5 system. Hose assemblies and appropriate components interconnect the purifier and hydraulic power supply to enable fluid to be processed directly from the fluid reservoir. Fluid samples will be drawn from a sample port within the system and analyzed to determine the levels of contamination.

This test plan also applies to MIL-H-46170 hydraulic fluid using the PALL hydraulic purifier. However, a fluid reservoir with appropriate connections will have to be devised to interface with the existing hose components. Suggestions for a fluid reservoir are presented herein.

Reconditioning and maintenance data will be collected for 1 year. These data will be periodically analyzed to monitor the feasibility of the reconditioning process.

3.1.1 Requirements

- **Particle Counter:** The particle counter shall be within its calibration cycle.

- **Fluid Sample Bottle:** The following containers are acceptable for fluid collection.

  - **Flint Glass Bottle:** National Stock Number (NSN) 8123-00-543-7699
  - **Plastic Sample Bottle:** Part Number (P/N) XX6504709 (from Contamination Analysis Kit, P/N 57L414).

CAUTION: The plastic bottle shall not be used if the sample will be stored for more than 24 hours.

- **Hydraulic Purifier:** The hydraulic purifier shall only be operated by qualified personnel.

- **Hydraulic Hose Interface Connections to the T-5:** The connections shall be in general accordance with supplied figures.

- **Safety:** Caution shall be exercised in the application of the hydraulic purifier. Refer to the warnings and cautions in the purifier technical manuals. However, do not:

  - Combine hydraulic fluids formulated to different specifications (*e.g.,* MIL-H-83282 and MIL-H-46170).
  - Combine fluids of different types within the same specification (*e.g.,* MIL-H-46170, Types I and II).
  - Introduce flammable or explosive solvents or fluids of any type.
  - Apply pressurized air to the purifier intake.
  - Change sampling points during the purification process.

3.1.2 Procedures

The following procedures describe methods for acquiring fluid test samples from a sample port. These samples will be evaluated to determine the performance of the hydraulic purifiers relative to reducing fluid contamination to levels that render the fluid acceptable for reuse in ground support equipment.

3.1.2.1 A/M27T-5 Reservoir

1. Interconnect the hydraulic supply as described in Section 4.0. Ensure that the reservoir sump is drained of water, the hydraulic fluid reservoir is filled to capacity, and all applicable hydraulic connectors have been cleaned and connected. Establish the fitting to be used as a sampling port.

2. Prepare the sample port, as follows.

    a. Remove dirt and other external contaminants by washing it with cleaning solvent P-D-680, Type II. The solvent shall be dispensed from a nonfiltered wash bottle, and the sampling point shall be wiped clean using disposable wiping cloths.

    b. When the sampling port is visibly clean and free of external contaminants, perform a final solvent wash using the wash bottle and allow it to dry.

3. Recirculate the fluid for at least 5 minutes at full flow (or proportionally longer at a lower flow rate) before sampling the support equipment hydraulic system fluid.

4. Collect a fluid sample, as follows.

    a. Drain the sample bottle of any hydraulic fluid remaining from the previous sample or use a new sample bottle. ***Do not rinse*** the sample bottle with solvent.

    b. Initiate the flow of hydraulic fluid from the sampling port of the hydraulic supply and allow a purge quantity of approximately five times the stagnant volume to flow into a waste receptacle.

    c. Rinse the sample bottle with system fluid. After purging the dead volume, fill it half-full with fluid collected from the sampling port. Cap the bottle and shake it for at least 1 minute. Drain the bottle into the waste receptacle.

    d. Without interrupting the fluid flow from the sampling port, fill the rinsed sample bottle to an appropriate level, remove from the fluid stream, and cap.

        – **Fluid Level for Flint Glass Bottle:** Approximately 1 inch (25 mm) below the shoulder

- **Fluid Level for Plastic Bottle:** Approximately 1/4 inch (6 mm) below the shoulder

e. Terminate the fluid flow from the sampling port.

f. Turn off the power supply system main engine.

g. Set the reservoir selector valve to Test Stand Reservoir to connect the fluid reservoir to the power supply hydraulic system (Reference: NAVAIR 17-15BF-89, WP003 00, page 15, index number 4). This allows fluid circulation between the suction return port and the reservoir drain of the T-5.

h. Analyze the hydraulic fluid drawn from the sample port for the following and enter the results on the data sheet:

- **Particulate Concentrations:** Navy Standard Class
- **Free/Entrained Water Concentration:** ppm
- **Dissolved Water Concentration:** ppm
- **Chlorinated Solvent Concentration:** ppm

i. Complete the appropriate sections of the Hydraulic Purifier Performance Data Form.

CAUTION: Due to the sensitivity of the particle counters, it is imperative to have clean fluid samples. The following observations are to be made.

- Sampling port shall be clean.
- Sampling port shall be purged to remove stagnant fluid.
- Sample bottle shall be rinsed with fluid from the sample port after purging stagnant fluid.
- Sampling flow shall be continuous—from the purging through the filling of the sample bottle—after which it will be discontinued.
- Only one sampling point shall be used during the purification process.

NOTE: Sampling ports and bottles that are insufficiently cleaned will result in erroneous data. This will result in the fluid failing the test and additional purification time and labor.

5. Initiate operation of the purifier. The purifier start-up and operation should be conducted in conformance with the procedures outlined in the operations manual and the directions received during training. This cycle time may increase at high ambient temperatures and/or humidity to drive off dissolved water.

6. Repeat steps 2, 3, and 4.

7. If the following levels are not accomplished, repeat steps 5 and 6.

- **Particulate Concentrations:** Navy Standard Class 3 minimum
- **Free/Entrained Water:** 0 ppm
- **Dissolved Water Concentration:** 250 ppm maximum
- **Chlorinated Solvent Concentration:** 100 ppm maximum

8. Complete the appropriate sections of the Hydraulic Purifier Performance Data Form.

3.1.2.2 Reservoir Other Than T-5

1. Interconnect the purifier hydraulic supply and return the lines to the reservoir provided for the MIL-H-46170 hydraulic fluid (see paragraph 4.4). Ensure that the reservoir sump is drained of water, the hydraulic fluid reservoir is filled to capacity (suggested 15 gallon minimum), and all applicable hydraulic connectors have been cleaned and connected. Establish the fittings to be used for the sampling port.

2. Perform step 2 in paragraph 3.1.2.1.

3. Collect the fluid sample. Ensure that the reservoir has ample fluid agitation throughout the reconditioning process.

4. Repeat steps 4 through 7 in paragraph 3.1.2.1, as applicable.

3.1.3 Instructions for Completing Hydraulic Purifier Performance Data Form

- **Reference Number:** Indicate the reference line number

- **Date:** Indicate the date the reconditioning process was accomplished (month/day/year).

- **Particle Counter Instrument:** Indicate the instrument (*e.g.,* HYAC/ROYCO 8011 or Diagnetics DCA) used to measure the particulate concentrations. The technician must verify that the instrument is within its calibration cycle.

- **Relative Humidity (%):** Indicate the average relative humidity recorded at the naval station during the reconditioning process.

- **Temperature:** Record the average temperature of the hydraulic fluid during the reconditioning process.

- **Quantity (Gallons):** Record the number of gallons of hydraulic fluid processed.

- **Hydraulic Supply:** Indicate the hydraulic supply from which the fluid was processed (*e.g.,* A/M27T-5 or other reservoir) by entering the system identifying number. Agitation of the mixture will be accomplished by fluid recirculation set up within the tank/reservoir during reconditioning. (Drain the hydraulic fluid from the supply/reservoir sump to remove free water. Decant the drained solution; return the

fluid to the reservoir for reconditioning; and dispose of the water in the proper manner.)

- **Initial Fluid Contamination:** Before processing the fluid, record the following data in the spaces indicated.
  - **Particulate Concentration (Navy Standard Class):** Indicate the Navy Standard Class that defines the particle distribution measurement obtained for the unprocessed fluid.
  - **Free/Entrained Water Concentration:** Indicate the amount (in ppm) of free/entrained water. (Use Karl Fischer reagent or an equivalent method to obtain the data.)
  - **Dissolved Water Concentration:** Indicate the amount (in ppm) of dissolved water. (Use Karl Fischer reagent or an equivalent method to obtain the data.)
  - **Chlorinated Solvent Concentration:** Indicate the amount (in ppm) of chlorinated solvent contamination. (It is recommended that an outside source be used for analysis.)
- **Purification Time:** Indicate the start and finish time of the fluid reconditioning process.
- **Final Fluid Contamination:** After processing the fluid, record the following data in the spaces indicated.
  - **Particulate Concentration (Navy Standard Class):** Indicate the Navy Standard Class that defines the particle distribution measurement obtained for the processed fluid.
  - **Free/Entrained Water Concentration:** Indicate the amount (in ppm) of free/entrained water. (Use Karl Fischer reagent or an equivalent method to obtain the data.)
  - **Dissolved Water Concentration:** Indicate the amount (in ppm) of dissolved water. (Use Karl Fischer reagent or an equivalent method to obtain the data.)
  - **Chlorinated Solvent Concentration:** Indicate the amount (in ppm) of chlorinated solvent contamination. (It is recommended that an outside source be used for analysis.)
- **Rate/Technician:** Indicate the rate and name of the cognizant individual for fluid processing and data entry.

- **Qualitative Assessment:** Provide a narrative evaluation of the unit's performance. Briefly discusses:
  - Efficiency of the method (*e.g.,* time and cost savings)
  - Ease of use and the unit's ability to successfully interface with site operations.

3.1.4 Instructions for Completing Filter Replacement Tracking Form

- **Reference Number:** Indicate the reference line number.
- **Date:** Indicate the date the filter was changed (month/day/year).
- **Filter Change-Out:** Check the appropriate block to indicate when a filter was changed-out. Check A if the filter was changed after the reconditioning process; check B if the filter was changed before the reconditioning process.

The initial inventory of spare filters received with each purifier are based on processing an estimated 500 gallons of hydraulic fluid per month over a 6 month period. However, until fluid reconditioning test data are compiled and analyzed, each filter shall be reordered when it is changed-out in the system. The filters received with each system are as follows.

System	Purifier Filter	Initial Inventory
PALL Aeropower Corporation PE-00440-1H	GC-00273F-168H, Discharge	6
	AA-4463F-1, Coalescing	3
	PA-00440-1A, Air Inlet	4
Hydraulic International, Inc. HPU-1-5	62620-100, Contamination	2
	9927808, Water Separator	2
	LE-10AZ, Water Separator	2

3.1.5 Data Sheets

Copies of the completed data sheets should be forwarded to SEMCOR on a monthly basis. Submittal shall be independent of the amount of fluid processed.

3.1.6 Maintenance Records

Copies of maintenance records—including preventive, repair, and warranty activities (including labor hours and any extended downtime)—should be forwarded to SEMCOR.

4.0 A/M27T-5 HYDRAULIC CONNECTIONS

Fluid reconditioning using the T-5 supply system reservoir eliminates the requirement for off-line equipment, minimizes fluid contamination, and reduces the labor related to fluid reconditioning. The A/M27T-5 system connections for a fluid purifier were recommended by the manufacturer. Interconnecting hose assemblies are essentially fixed to the purifier via NPT threads and coupled to the T-5 with self-sealing quick disconnect fluid couplings.

4.1 Recommended Connections

The recommended connections between the T-5 and the purifier are as follows.

- Purifier Pressure Port (Outlet) to the T-5 Suction Return Port (Reference: NAVAIR 17-15BF-89, 11-1-90, Work Package 003 00, page 17, item number 25)

- Reservoir Drain Valve (1.0 FNPT) of the T-5 Hydraulic Reservoir (Reference: NAVAIR 17-15BF-89, 11-1-90, Work Package 003 00, page 13, index number 2). This valve was recommended as the fluid supply to the purifier inlet port.

4.2 Hose Assembly/Components

The hose assembly/component configurations for the purifier fluid supply (inlet) are the same for both systems and differ only in the fitting required to adapt the hose assembly to the purifier. The HPU-1-5 requires a 1.0 MNPT and the PALL requires a 3/4 MNPT AN816 type adapter.

4.3 Reservoir Drain Adaptation

The AN816 adapter fitting should be installed into the reservoir drain fitting after the fitting's interior is cleaned in accordance with step 2 in paragraph 3.1.2.1. Use appropriate methods for sealing threads when installing the adapter fitting. Once installed, this fitting should remain in place. Normally, this fitting will have the AN929-16 cap assembly installed to prevent the entry of contaminants. It must be removed to drain the reservoir sump or to connect the -16 jumper tubing used to interconnect the quick disconnect, self-sealing hydraulic coupling.

4.4 Reservoir Other Than T-5

The minimum fluid capacity for an off-line reservoir (other than T-5) should be 10 gallons minimum—with provisions for an agitation device (*e.g.,* a commercial stirrer). A tank having a conical bottom with a 1-1/4 NPT port at the apex is desirable for the fluid supply to the purifier. The return flow from the purifier should be located below the fluid level in the reservoir and directed to obtain the best circulation without agitator operation. The sampling port pickup line should be rigid and have its pickup point in the proximity of maximum circulation. Do not use a flexible sampling pickup line. The fluid sample pickup point must be repeatable (*i.e.,* fixed).

The hydraulic fluid hose assembly/components are readily adaptable to reservoirs other than the T-5. Basically, the 1.0 NPT adapter that engaged the T-5 reservoir drain valve can be coupled to the conical bottom of the tank and the -16 self-sealing, quick disconnect coupling can be half-installed as part of the tank assembly.

The fluid return fitting that will be part of the tank assembly should mate with the -20 self-sealing, quick disconnect half-coupling on the hose assembly. Although these parts are available from another manufacturer, delivery is approximately twice as long.

Other than interconnecting an off-line reservoir, all other aspects of hydraulic fluid reconditioning are basically the same as for reconditioning using the A/M27T-5 hydraulic power supply.

5.0 FINAL REPORT

The data entry forms are a concise method of data collection. The forms should be completed on a daily basis. Data will be collected for 1 year. During this time, periodic status reports on the testing will be submitted to NAWCADLKE. The final report will include detailed results and observations, assess the efficiency and cost-effectiveness of the unit, and evaluate its ability to interface with site operations.

Hydraulic Purifier Performance Data Form

Ref. No.	Date	Purifier		Relative Humidity %	Temp.	Qty. (Gal.)	Hydraulic Supply	Initial Fluid Contamination				Purification Time		Final Fluid Contamination				Rate/ Tech.
		PALL	HI					Particulates (Navy Class)	Free/ Entrained Water	Dissolved Water	Chlorinated Solvent	Start	Finish	Particulates (Navy Class)	Free/ Entrained Water	Dissolved Water	Chlorinated Solvent	

Qualitative Assessment*:
Please comment on the effectiveness and efficiency of the units.

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*Attach extra sheet if required.

Filter Replacement Tracking Form

Ref. No.	Date	Filter Change-Out											
		PALL						HI					
		GC-00273F-168H		AA-4463F-1		PA-00440F-1A		MIL-F-81836		62620-100		LE-10AZ	
		A	B	A	B	A	B	A	B	A	B	A	B